Keating (J. M.)

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REPRINTED FROM

The Annals of Hygiene

FOR JULY 1st, 1886.

THE ARTIFICIAL FEEDING OF INFANTS.*

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Visiting Obstetrician to the Philadelphia Hospital, and Lecturer on Diseases of Women and Children. Physician to St. Joseph's Hospital. Fellow of the College of Physicians, etc., etc.

The honor that was conferred upon me by the request to present a paper to this meeting, carried with it a responsibility which I freely confess, the more I look into the subject, by no means lessens. The large audience which I address, gathered as they are from all portions of the Union, have come here to carry away to their constituents certain facts which I have endeavored to deduct from the mass of published material, and which are to be used for no less a purpose than the attempt at saving life.

Were my hearers alone members of the medical profession, it would not be necessary for me to explain the reason why so much stress is laid upon a subject which appears so simple, nor would I be required to throw the veil over the various apparent discrepancies and contradictory statements that pervade the literature of my subject. They know full well that thousands yearly die in early infancy from disease which is the offshoot of ignorance and carelessness.

They also know that science is not progressive by rapid strides in lines that are straight, but that its true progress is slow, tentative; its path marked by discussions; ofttimes it seems to retrograde, and then, discovering a new way, it abandons the old one, but in the long run reaches the goal.

Men's ambition for fame and desire for riches seem for a time to cover the track of progressive science, to anticipate it, to lead it on, but the spark burns brightly beneath.

To my non-medical hearers I will say that, in answer to your question, Why is it that so many apparent differences exist regarding the bringing up of infants? I reply that it is not because science has ceased to advance in this direction, but because we are situated in its pathway, and not at its goal.

We are learning from the chemist the composition of human milk—of nature's food; from the physiologist the composition of the secretions; from the anatomist the laws of growth and development of the human body.

These studies are intricate; they require frequent corrections, and, as a consequence, the sum total is affected by discrepancies existing in the figures of the component parts.

I believe that it is better for us to-day to avoid questions that are still *sub judice*, and confine ourselves as closely as possible to such facts as will warrant our basing some conclusions upon them.

Let me for a moment give you a few statistics to show you the importance of our subject. We are entering the season of the year during which intestinal disorders among infants give us a mortality that is appalling. I believe that if you will carefully study the matter which I will present to you, and disseminate these suggestions, which are based not alone upon my experience, but upon that of others, you will be benefactors—more than that, you will save life.

The tables I present, compiled from the census reports of 1880, prove several interesting points. One is the enormous increase of mortality during the heated season; the other, the fact that the much dreaded *second* summer has a low comparative death rate. Thus, in New York and Pennsylvania for 1880, 35,377 chil-

* Read before the State Sanitary Convention, held in Philadelphia May 12th, 13th and 14th.

dren died within the *first* year (inclusive), and but 6031 between the first and second years, and 4139 between the second and third years.

As we know that disorders of the intestinal tract cause a very large proportion of these deaths, and that the attempt at artificial feeding is usually productive of unfortunate results, too much attention cannot be paid to the subject. Disraeli, in one of his best novels, tells us that "mother's milk makes the true-born Englishman." Mother's milk is undoubtedly the proper food for the new-born infant, and though I believe we have reached a degree of accuracy in the matter of food preparations and knowledge of the infant requirements that would in a great degree show itself in a diminished death rate, could we secure the thorough co-operation of intelligent nurses and mothers.

I cannot but regret the tendency which the imperative dictates of fashion bring about, to the development of feeble women who are ill fitted to bear the burdens of maternity, or to nourish the children they bear. Wet-nursing and bottle feeding should be discouraged except in cases of absolute necessity.

But let us suppose that for some excellent reason mother's milk is not obtainable and the wet nurse question has been decided adversely, upon what and how should an infant be fed?

We will at once agree that *milk* should form the basis of an infant's diet.

It is composed of five different classes of material which are essential to nutrition; water, casein and albuminoids, salts which go to the formation of bone and secretions, fats and sugar, or the carbohydrates, which latter two have much the same action.

The child gets the same food as the adult, but it gets it in a condition more easily digested and more readily absorbed. More than 87 parts in a hundred of its food is water, but when the chemist tells us that 70% of the human body weight is water, its importance is readily recognized. Then we have the nitrogenous group represented by the casein, the muscle forming; and then the fats and sugar which maintain the animal heat, and the salts for bone and secretion. Digestion is a solution by hydration, so that the elements acted upon may pass readily through the wall of the alimentary canal, after which they are dehydrated.

You see that digestion is not merely a process of disintegration; certain secretions are requisite to bring about the chemical changes required—what are these secretiens? First we have that from the salivary glands; the saliva secreted by a child under six months is at a minimum, very little is required, simply enough to lubricate, but I may say that in a series of experiments I have recorded, a child of 7 days who secreted saliva which possessed sufficient diastase to convert the boiled starch used into grape sugar. This readily accounts for those infants who fatten on corn starch, much to the surprise of the family medical attendant.

As the child grows and teething begins, quite a large amount of saliva is secreted, and undoubtedly the activity of this secretion forms a prominent part in its digestive process; in other words a child that slobbers as a rule has little digestive disturbance.

From birth the gastric juice takes a prominent part. By it the curd is precipitated and turned into peptones or albuminose. All albuminous matter is so converted, and a burden by no means light is placed upon the liver, an organ more prominent in infancy than in adult life, to dehydrate this material which now courses through it, to maintain its glycogenic function, and to throw off those refuse matters that are discharged into it.

The precepitation by gastric juice of

the casein presents some curious features, indeed this matter is of fundamental importance in our studies. Woman's milk is alkaline, it is watery, its curd is precipitated in soft flakes. Cow's milk is slightly acid, its curd forms in firm hard masses of cheesy consistence. Brush, in 1879, told us that the curd in all cud-chewing animals, of which the cow represents the class, was thrown down in masses so as to be readily regurgitated by the calf for the purpose of trituration. In the non-cud-chewers the reverse is the rule. There may be other peculiarities of the curd, chemical differences, but these have not as yet been determined.

The secretion of the pancreas is the next and last of importance. It is composed principally of two materials, in fact a third may be added, the curdling principle; these will act in an alkaline or faintly acid solution: the first a material analogous to the pepsin of gastric juice which converts casein or other albuminous matters into peptones, such substances that have escaped the action of the gastric juice, and a *diastase* like that of the saliva which converts starchy matters and cane sugar into dextrine or grape sugar.

To the infant the gastric juice is the most important of its secretions, only such food as contains albuminous matter with soluble carbo-hydrates as glucose and oil in emulsion should be given—such, indeed, is milk.

We have then two matters to consider in the artificial feeding of infants—and I shall limit myself to those within the first year—one, the preparation of a food containing the elements of mother's milk, in a combination as much like it as possible; and the other, no less important, the elaboration of those secretions which digest it—an equal balance must be maintained between the two. I will confine myself to the questions of the former. With all due respect for the opinions of those who have endeavored to give us an accurate analysis of woman's milk, I feel that in basing upon it any preparation that would be invariably scientifically correct, we would fail in the very line which nature herself has clearly drawn for us, that is by not giving sufficient latitude for the different organizations of different individuals.

Granting that the human milk is the proper basis to start upon, how much food does a child require in 24 hours? So much depends on the infant: if the bowels are normal, and there is no evidence of indigestion, the breath sweet and the child seems desirous for more after it has finished its bottle, there is no reason why it should not be satisfied. A child of a month should be nursed about ten times in 24 hours, every two hours during the day and three hours during the night: at each nursing it should take from two to three ounces of milk. At the age of about three months it will probably nurse only about eight times, taking about six ounces at each feeding; at the end of about six months it will take about eight ounces. I believe that this would represent about the amount of breast milk that such a child would receive.

Having now stated the amount of food that a child requires, let us dwell at some length on the character of its diet and its preparation. In order that the directions may be carried out thoroughly they should be made as simple as possible. We all acknowledge that cow's milk has the following advantages: it serves as the basis for the preparation of a milk resembling that of the human mother, it possesses all the ingredients that are necessary for nutrition, it is easy to obtain. Its disadvantages are, that the relative proportion existing between its different constituents is not that found in mother's milk, it possesses a form of casein which forms hard curds, this casein exists in larger amounts, at least twice or more than in human milk.

It is impossible for the child to nurse directly from the cow, and therefore a certain time must elapse during which the milk undergoes possibly some alteration from exposure to the air, is liable to be tainted with the germs which produce decomposition, and this indeed is the greatest objection to its use in our large cities. It is acid, though precisely what affect this has, or what it is due to, is not exactly clear to my mind.

But these objections can be readily obviated by the following means: the milk from an ordinary dairy should be obtained as fresh as possible, mix together a half of a pint of this milk and a half of a pint of pure water, and to this should be added about two hundred grains or two heaping teaspoonfuls of milk sugar, with four grains of bicarbonate of soda; it should then be brought to a boil, after which two tablespoonfuls of cream should be stirred in, and it is ready for use, to be given by bottle or drinking cup, at about the body temperature.

We have here a mixture, which, according to Leeds, closely resembles mother's milk; we have also a preparation which has been freed by boiling from the objection stated above, in cow's milk, that due to a tendency to fermentation, and indeed the milk is rendered more digestible by it.

In new born children or those a month or two old, we may diminish the amount of casein and increase the amount of sugar by the following means: Take one ounce of ordinary milk, three ounces of water; add one ounce of ordinary cream and about a level teaspoonful and half (80 grs.) of milk sugar. Indeed, it is better to run the risk of making a mixture with too little casein than with too much, gradually increasing strength of the milk by diminishing the water, as the child grows older; but it should also be borne in mind that as we increase the water we should also increase the carbo-hydrates, by adding either sugar of milk or some of the malted foods. Sugar of milk rapidly sours and turns to lactic acid when dissolved in water; and indeed, I believe that on this account there is little choice between it and *cane* sugar. In a case of diarrhœa, I would leave out *sugar* altogether. My own experience teaches me that with care, cane sugar has not the disadvantages in most cases, in winter, that some fear.

This brings us to the subject of condensed milk; a reliable brand of Borden or Canfield's has the following advantages: When diluted with 5 to 10 parts of water, it represents mother's milk pretty closely, with the exception that there is less cream, but to a pint of this mixture four tablespoonfuls can readily be added. The evaporation of the milk in its preparation has destroyed its tendency to fermentation to a great extent, this most certainly is a great advantage; it will coagulate in flakes, and does not require the addition of any sugar, as by analysis it is shown that when the mixture is thus prepared, the amount of sugar it contains is about equal to mother's milk. It can be universally obtained, and is useful on that score; its disadvantage in many instances is due to the cane sugar, and some object to it on the ground that it is supposed in many cases to lead to rickets.

My own experience does not bear this out, though certainly if I were to find that a child fed on condensed milk should show undue acidity, either in its stools or its breath, due to the presence of lactic acid, I would at once change its diet. This, careful watching should avoid.

In summer weather the presence of cane sugar, which is a decided laxative, is objectionable, and herein exists the great difficulty of the proper selection of a food for that season.

In order to counteract any tendency to rickets, I usually incorporate in the milk

some lime—either lime water, or still better, I think, the lactophosphate and carbonate of lime; indeed I would establish this as a rule in the preparation of all milk foods that require the addition of sugar. In my opinion, lime water falls far short of reaching the good claimed for it. When we come to consider that only *eleven* grains of lime are found in the pint, two tablespoonfuls will contain about one-third of a grain, too small an amount by far to be of any service whatever in either neutralizing any undue acidity, or of any service in supplying lime to the tissues; it will need equal parts to accomplish the former; the probability is that it is the dilution of the milk which is beneficial in cases where it is thus used.

I have made some very interesting experiments in this line with Mr. Louis Genois, the result of which is as follows: To a half of an ounce of ordinary milk, eight drops of dilute muriatic acid were added, and a curd was thrown down irregular and lumpy. The same milk was taken, and to half an ounce a half grain of lacto-phosphate of lime was added, and the same acid used; the precipitate was smooth, fine, and in fact creamy. The solubility of this preparation of lime, its action on the curd, and its value in counteracting the great tendency to rickets, which I believe exists in all hand-fed children, gives the matter great importance.

For this reason I have had made for me some compressed tablets, each containing a certain proportion of sugar of milk, lime in a soluble form, and carbonate of lime, which will, with a small amount of soda, neutralize any undue acidity of the milk. A certain quantity of water is taken, brought to the boiling point, and to this is added the needed amount of milk, say an equal part, in which has been dissolved two or more tablets, and to this is added the necessary amount of cream, and given to the infant in nursing-bottle or by spoon, at the required temperature. Certainly the most stupid mother cannot fail to follow directions so easy. I may say here that this food would be most valuable for nursing women; the loss of teeth, so common during the child-bearing period, is due to a want of lime supply. Nursing mothers should take lime for themselves and for their milk.*

Let us study for a moment the question of the "fresh evaporated milk," served daily in some cities by the Canfield Company, and which, I think, offers for the future the best field for infant feeding, in those cities where it is daily supplied, especially in summer time. The following is its analysis, as given by Prof. Chandler, of New York:†

Water	52.74	+
Butter	13.70	+
Casein	15.04	+
Sugar	15.80	+
Salts	2.71	+

If we add seven (7) parts of water previously boiled or filtered, we have a mixture of which the following will represent the analysis:

Water,	94.8
Butter,	1.72
Casein,	1.88
Sugar,	1.98
Salts,	.34

* These tablets are prepared by J. J. Ottinger, Twentieth and Spruce streets, Philadelphia.

† 1 quart of water weighs 2.082 pounds.

1 quart of milk (sp. gr. 1.035 weighs 2.149 pounds.

430 quarts fresh milk=924 pounds.

Deduct 330 quarts of water, removed by evaporation=68.7 pounds.

We have 100 quarts condensed (evaporated milk)=237 pounds.

Now, 430 quarts (926 pounds) fresh milk at $12\frac{55}{100}$ per cent. solids contains 116 pounds solids; 100 quarts of condensed milk (evaporated) (237 pounds) at $46\frac{46}{100}$ per cent. solids contains 110 pounds solids. C. F. CHANDER.

Report of Commissioners Public Charities, New York, 1871, p. 216.

Then, taking an analysis of mother's milk:

Water,	87.16
Fat,	4.28
Casein,	1.04
Sugar,	7.4
Ash,	.1

We find that it will be necessary to add to the half pint of the above mixture of evaporated milk, two (2) tablespoonfuls of cream and two (2) heaping teaspoonfuls of sugar of milk. This will be equal to cow's milk, with about the same percentage of casein as mother's milk. The absence of cane sugar in this preparation renders it most valuable in summer in our large cities when diarrhœa is prevalent. Indeed, in such cases half of an ounce of this milk in a graduated glass with four ounces of water, previously boiled and filtered, given at the temperature of the body, about 99°, without adding cream or sugar, would in many cases be a most suitable diet. If the bowels are loose, lime water could be used. Unquestionably disorders of the intestinal tract are produced by *fermentation* and also by *mechanical irritation* of undigested curds, and this is often due to not alone the method of preparing the food, but also to the deficient supply of the gastric juices. If a large supply of gastric juice could be encouraged, both of these causes would cease to exist, as the acid mixture is antiputrefactive as well as digestive. Indeed, the acid treatment of summer diarrhœa is an admirable and recognized one, but the limited amount of pepsin and hydrochloric acid that we can administer as a corrective is in many cases insufficient. On this account we are obliged to use some means so as to prepare the milk and destroy its ferments, and to diminish its casein, or so affect it as to allow precipitation in fine masses. The former is readily accomplished by boiling, or by subjecting the milk to heated steam, the latter by several means now in vogue.

The *first*, by rendering the milk alkaline, which retards in a measure the coagulating property of the gastric juice.

The *second*, by diluting the milk with water, which diminishes the percentage of casein.

The *third*, by thoroughly incorporating with it some material, such as gelatine, or a small amount of starchy matter, such as oatmeal water, that will intimately incorporate itself in the casein as it falls, and thus allow the gastric juice to completely attack it; and, *fourthly*, to partially predigest the casein, peptonize it as it is called, before it enters the stomach.

We have, in addition to these, various other preparations, which are sometimes added to the milk to render it more nutritious, for example, soluble carbo-hydrates, as dextrine, glucose, or substances rich in albuminous matters. This in fact covers the whole ground of the various preparations used in the bottle feeding of infants, and you will thus see that they all have some scientific basis to work upon, and their choice questions of expediency and reliability, which should be studied in connection with each particular case.

Let us study these matters *seriatim*. The experiments of Reichmann, and indeed our own experience, show that boiled milk is more digestible than raw. All city children under a year, and in those older who are passing through the heated term, with whatever form of diet in use having milk as a basis, I would certainly advise that the milk be brought to a boil, or at least thoroughly scalded. Of course, if condensed or recently evaporated milk be used, this is not necessary.

Boiling has another great advantage; it is germ-destroying, and possibly milk contaminated by the contagium of scarlatina, typhoid fever, or even tuberculosis, may be rendered harmless thereby. Let us now take up in turn the *four* divisions of our subject:

1. Cow's milk can readily be rendered alkaline by the addition of lime water in large amounts, soda or potash, and the curd affected thereby. I think the importance of alkalinity is somewhat overrated, that is, the tendency seems to be to put too much soda in the milk; all that is required is to make it neutral, even for peptonizing purposes.

2. Dilution with water, which should always be previously filtered, to the amount of once or twice its bulk, will so affect the percentage of casein in cow's milk as to bring it to that of the woman, and also will control the precipitation of the curd, even should the milk remain slightly acid. But this will also reduce the amount of cream and sugar; these must be added.

The question of the digestion of fat needs but a few words. It is greatest in demand at the time when animal heat is the most required, that is during the winter months, the fats and soluble carbohydrates when supplied in excess are stored for future use; their excess in hot seasons is productive of intestinal disorders. In such cases a change to albuminous water, made by dissolving the white of egg in water makes a nutritious diet and is a valuable change. The oils when stored away give a condition of body which is firm and elastic to the touch, and when this reserve is called upon the emaciation is gradual. On the contrary, when the storage takes place from excess of glucose, the fat is not *staying* and its disappearance is sudden. This is well seen in children fattened on condensed milk to which no cream has been added. It is admirably described by Dr. Weir Mitchell in his book.

Lessen then the amount of cream and sugar for the summer season, increase the nitrogenous elements, and render it as readily digestible as possible.

3. There are certain materials which require other juices than the gastric secretions to digest them, and which mingling with the curd allow the gastric juice to precipitate it slowly and thoroughly attack it. These are the cereals. The starchy granules must be thoroughly broken up by boiling or by dry heat, so that either the saliva or the secretion of the pancreas can change the insoluble starch into soluble grape sugar. The infant secretes but little saliva and probably but little of the pancreatic diastase; on this account but a small amount of starchy food should be given it. The milk can be diluted with its bulk of water, which can be previously thoroughly boiled with either ground barley, oat-meal or baked flour, in the proportion of a dessertspoonful to the pint, the milk poured in while the water is boiling, the whole boiled together for a moment and then strained. This can be sweetened, a small amount of cream added, and it forms an excellent food for a child after its fourth month; earlier than that I would prefer the plain milk diet.

The starch should always be placed in a position so as to readily facilitate its conversion into grape sugar, which can be done either by heat or by malting.

Fothergill tells us "By heat the cook cracks the starch granule so that the solvent diastase can readily act upon it. So far, so good; but heat does something more. It has an actual solvent action, and heat will, if sufficient, cause conversion of starch into dextrine. A thoroughly well baked flour if subjected to the iodine test under a microscope will readily show this.

"When a large quantity of raw unconverted starch enters the stomach it is a burden to that viscus. The gastric juice has no effect upon starch, and the starch granules merely embarrass the action of the stomach until they find their way out of it by the pyloric ring.

"The advantage of the numerous prepared foods—whether babies' foods or inva-

lids' foods—which are all more or less compounds of starch which has been to as certain extent predigested either by baking or the malting process, lies in their ready digestibility. A touch of saliva is enough to complete the conversion of such carbohydrates, and the soluble matters pass out of the alimentary canal, and the stomach is not burdened with a weight of undigested starch impeding its work.

"Starch granules which have escaped the saliva interfere with the solvent action of the gastric juice on albuminoids."

4. The casein can be previously partially digested by adding to the milk the pancreatic secretion, that which is analogous to the pepsine of the gastric juice, but which is deprived of its curdling element, and which acts in an alkaline or faintly acid medium.

The peptonizing process, or that of converting casein into peptones, can be arrested by boiling the milk just before it assumes a bitter taste, which completely digested material of this sort has.

The value of Fairchild's extract of pancreas in its relation to artificial feeding cannot be overestimated; the milk should be made very slightly alkaline by a small amount of soda. I think too much soda is usually recommended for infant use.

The peptogenic milk powder contains a certain proportion of extract of pancreas, sugar of milk, soda and salts, as suggested by Professor Leeds, and when used with cow's milk and cream forms a combination like mother's milk with the curd partially digested.

I sincerely trust that I have succeeded in convincing you so far that the question involved in the diet of an infant within its first year is simple enough. It is not by making these matters complex that we will accomplish our purpose—not by surrounding them with the impenetrable network of scientific analyses. Our *sums* should be done in private in the laboratory. Our instructions should be made so simple that every mother or nurse can carry them out, But let me for a moment bring before you a tangled mass of material which we will endeavor to unravel; for I know much confusion exists in the lay mind in regard to it—that of the preparations used in the artificial feeding of infants—*baby foods*. We can consider them under three headings.

The *first*, the milk foods. I have already spoken of condensed milk, and need dwell no further upon it. Nestlé's food, which contains condensed milk, dried, with starch and glucose, is largely used. Its composition, according to Stutzer of Bonn, the analysis of which I attach to this paper, would lead me to recommend it only after the child has reached the fourth or sixth month. Carnrick's soluble food is also valuable on account of its large amount of albuminoids and fats; it also contains milk which has been peptonized. The amount of starch which is shown in the analysis would lead me to recommend its most extensive use after the fourth or sixth month. Containing as it does a relatively large quantity of bone forming material (lime, phosphoric acid), it should stand very high as a food, and, indeed, in many cases might be used by very young infants. There are many other foods under this heading, but I will be obliged to refer you to the article on diet in J. Lewis Smith's book, page 58, 6th edition.

The *second* division comprises what are known as Liebig's foods. By this is understood dried preparations composed of grain, which has with it a certain amount of diastase or malt, and part of which has been converted into dextrine or grape sugar. They also contain albuminoids, which as you know are the nitrogenous elements, like the curd of milk. Some of these foods contain to a certain extent an amount of starch, which in many of them is in a condition readily to be converted

by heat and moisture into a soluble grape sugar. Their efficiency and digestibility depend on the amount of glucose and albuminoids which they contain.

As a rule, they should be used with milk after the child has reached its fourth month, though at a very much earlier period in many cases they have been found very useful.

From the analysis of Stutzer, the most recent made, I would place Mellin's and Horlick's food in advance of the others, on account of the large amount of the soluble hydro-carbons and albuminoids, and an exceedingly small amount of free starch. Of course, these foods should be used in small quantities, and always with milk ; at first they should be looked upon as so much sugar, only possessing, in addition to the grape sugar, certain very nutritious materials (albuminoids), which ordinary glucose has not, and also the bone-forming materials which we find in the cereals.

We now come to the *third* division, the farinaceous group, known as "wheat foods," including Imperial Granum and Ridge's food. They, in fact, are nothing more than starch which has been subjected to a more or less careful heating process, and can be used for children after four months, as I have suggested in a former part of this paper, when speaking of starches to aid the digestibility of casein. The starch granule in many of them has been thoroughly broken up by a careful heating process, and thus reached an advanced point towards its digestion in such foods as Hubbel's and Blair's wheat food.

I beg of you then to bear in mind that milk alone, with more or less alteration in the percentage of its ingredients, should serve as the food for a babe for at least two months.

The bringing up of children by the bottle is by no means as difficult as many think. All that is required is a thorough understanding of the object in view, by the doctor, nurse or mother, and thorough cleanliness and regularity, and an intelligent carrying out of matters that routine will soon render very simple. *But bear in mind that there can be no cast-iron rule by which all children are fed. Each child differs from another, and it is he who makes a study of each special case who will be most successful in accomplishing the purpose desired.*

1504 *Walnut street.*

BY DR. STUTZER. OF BONN, GERMANY.

	Dr. Ridge's Patent Food.	Horlick's Food	Wells, Richardson & Co.'s Lactated Food.	Mellin's Food	Carnrick's Soluble Food	Nestlé's Food
Fat	1.27	0,60	2,19	0,50	5.00	4.66
Protein substances (albuminoids)	8.76	11,30	9.05	8.34	18.22	11.46
Soluble hydrocarbons (sugars, dextrin, etc.)	1.79	65,92	25,52	60,89	26.87	41.22
Insoluble hydrocarbons (starch, etc.)	78.66	13,12	52,92	18.40	40,87	35.47
Cellulose	0.73	0,55	1,54	. . .	0.10	0.34
Water	8.31	5,75	6,52	7,76	6.14	5.34
Salts and inorganic constituents	0.48	2,76	2,26	3,53	2,99	1,75
Amount of nitrogen in protein substances	1.403	1,809	1.448	1.335	2.915	1,833
Amount of protein substances readily digestible	7.97	10,85	8.35	7.38	16.45	11.09
Proportion of nitrogenous alimentary substances (Protein = 1).	1: 9.3	1: 7,1	1: 9.2	1: 9.6	1: 4,4	1: 7. 7
The inorganic constituents contain Lime	0,060	0,060	0,390	0,155	0,645	0,390
The inorganic constituents contain Phosphoric acid	0.260	0,421	0,688	0,583	0,874	0,630

—From *Pharmaceut*, Central Halle, Berlin, 1886, No. 8; *Pharmac. Rundschau* (New York), 1886, page 89; *Buffalo Med. and Surg. Journal*, May, 1886, page 472.

DEATHS IN PENNSYLVANIA AND NEW YORK, FOR YEAR 1880.

		Under 1 year.	1 year . . .	2 years . . .	3 years . . .	4 years . . .	Total under 5 years . . .
Pennsylvania.	M.	7694	2274	1510	1034	782	13294
	F.	6048	1920	1310	918	780	10976
New York.	M.	11335	3139	1719	1113	821	18127
	F.	9179	2788	1492	1074	781	15314

Total deaths, in two States, under 5 years of age, 57,711.

Table showing for the United States and for 31 registration cities, the living population under 5 years of age, the number of deaths, and the number of deaths per 1000 of living population, compiled from U. S. Census Report for 1880.

		Under 1 year.	1 year.	2 years.	3 years.	4 years.	Under 5 years.
31 Registration Cities.	Proportion of deaths per 1000 living	267.5	87.4	36.7	24.7	17.9	88.4
	Deaths of Corresponding Ages	44249	11623	5977	3898	2824	68571
	Living Population . . .	165469	132933	162715	157646	156913	775676
United States.	Proportion of deaths per 1000 living	120.9	45.2	23.4	15.4	11.3	43.7
	Deaths of Corresponding Ages	175184	56816	33417	21276	15931	302624
	Living Population	1,447,983	1,256,965	1,427,086	1,381,274	1,401,217	6,914,516
Ages.		Under 1 year .	1 year.	2 years	3 years	4 years	Under 5 years .

Remarks: In considering this table it should be remembered that the reports of deaths for ths whole United States are defective from 15% to 30%, while for the cities they are nearly complete. It will be seen that for each 1000 living under 1 year of age in the United States at large the proportion of deaths was 120.9; while in the cities the number of deaths per 1000 of the same age was 267.5. Under 5 years of age the proportion of deaths in the country at large was 43.7 per 1000 of living population, while in the registration cities it was 88.4 per 1000. In other words, the mortality of children under 5 years of age, according to this table, was about twice as great in the cities as in the average of the whole country.

Table showing for the United States, for Massachusetts and for the principal countries of Europe, the number of deaths up to 5 years as compared to 100 deaths of all ages:

	Under 1 year.	1 to 5 years.	Year . . . .
United States	23.24	16.90	1880
Massachusetts	20.37	14.23	1880
Italy	24.77	20.60	1880
France	17.59	8.83	1879
Prussia	32.25	15.96	1880
Bavaria	39.48	10.71	1880
Saxony	42.00	15.34	1880
Thuringia	31.71	15.30	1880
Wurtemberg	41.78	11.92	1880
Baden	33.77	12.33	1880
Alsace and Lorraine . . .	28.74	11.96	1880
Austria	31.62	16.51	1880
Croatia and Slavonia . . .	30.44	19.37	1880
Switzerland	24.34	8.97	1880
Belgium	25.99	13.09	1880
Holland	31.01	14.10	1878
Sweden	19.58	13.68	1880
Norway	20.59	12.21	1878
Denmark	23.49	12.19	1880
Finland	25.55	18.73	1880
European Russia	38.82	20.81	1875
Spain	22.93	25.20	1865–70
Greece	18.09	17.30	1880
Roumania	23.54	19.33	1879
England and Wales. . . .	25.48	16.98	1880
Scotland	20.31	17.37	1878
Ireland	13.98	11.60	1880

Remarks: It will be seen by this table that as regards the proportions of the infantile to the whole mortality, the United States is near the mean, being exceeded in the proportion of deaths occurring under 1 year of age by Austria, Belgium, England and Wales, Germany, Holland, Italy and European Russia, while France, Sweden and Norway, Scotland and Ireland, have a lower rate.